

US Army Corps  
of Engineers  
New England Division

NOVEMBER 1984

# Drought Contingency Storage Plan

Barre Falls Dam, Barre, Massachusetts



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C-2

CONNECTICUT RIVER BASIN  
WARE RIVER WATERSHED

DROUGHT CONTINGENCY STORAGE PLAN  
BARRE FALLS DAM  
BARRE, MASSACHUSETTS

NOVEMBER 1984

NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
424 TRAPELO ROAD  
WALTHAM, MASSACHUSETTS 02254-9149

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## SYLLABUS

A drought contingency plan was studied for Barre Falls Dam in an effort to be responsive to public needs during drought situations. Due to the existing MDC water supply operations in the Ware River watershed, drought contingency storage plans would be precluded at Barre Falls Dam. Releases of excess floodwaters from Barre Falls Dam are currently coordinated with the water supply operations of the Metropolitan District Commission of the Commonwealth of Massachusetts, with released water diverted to the Quabbin and Wachusett Reservoirs by means of an aqueduct system from the Coldbrook intake.

DROUGHT CONTINGENCY PLAN  
BARRE FALLS DAM

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DROUGHT CONTINGENCY STORAGE PLAN  
BARRE FALLS DAM

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency storage plan of operation for Barre Falls Dam that would be responsible to public needs during drought periods and to identify possible constraints. This evaluation was based on preliminary studies using readily available information. This drought contingency plan includes a description of existing water supply systems, potential for water supply reallocation, and summary and conclusions..

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basin-wide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Barre Falls Dam was authorized as a flood control project for the Chicopee River watershed in the Flood Control Act of 18 August 1941 (Public Law No. 228, 78th Congress) and 22 December 1944 (Public Law No. 534, 78th Congress).

4. PROJECT DESCRIPTION

Barre Falls Dam is a single purpose flood control project, located in Barre, Massachusetts on the Ware River, built and operated by the Corps of Engineers. The dam is about 32 miles upstream of the confluence of the Ware and Swift Rivers and about 52 miles upstream of the mouth of the Chicopee River. A map of the Connecticut River basin is shown on plate 1. The reservoir has a total storage capacity of 24,000 acre-feet (7.8 billion gallons), equivalent to 8.2 inches of runoff from a drainage area of 55 square miles. A capacity table is

shown on plate 2 and a summary of pertinent data at Barre Falls Dam is contained on plate 3.

Components of the project consist of a rolled earth-filled dam with rock slope protection, concrete spillway, three dikes and the outlet works. The outlet works consist of an intake structure, a gate tower and a 9'8" diameter horseshoe conduit. The discharge through the conduit is controlled by two 4.5 foot wide by 9.0 foot high sluice gates.

The three dikes, with a maximum height of 48 feet, have a total length of 3,215 feet. The dikes are located in three saddles along the southern rim of the reservoir.

## 5. PRESENT OPERATING REGULATIONS

a. Normal Periods. The normal gate openings are 2'-2'. This gate setting automatically restricts discharges so that significant reservoir releases do not occur in the event of sudden increases in inflow. A winter pool is maintained at Barre Falls Dam at an elevation between 776 and 778 feet NGVD to prevent freezing of the flood control gates.

b. Flood Periods. The Barre Falls project is operated in concert with other flood control projects in the Connecticut River basin to reduce downstream flooding along the Ware, Chicopee and Connecticut Rivers. Operations for floods may be considered in three phases: phase I - appraisal of storm and river conditions during development of a flood; phase II - flow regulation and storage of flood runoff at the reservoir, and phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in the Master Water Control Manual for the Connecticut River Basin.

### c. Regulating Constraints

(1) Minimum Releases. A minimum release of about 10 cfs (6.5 mgd) is maintained during periods of flood regulation in order to sustain downstream fish life.

(2) Maximum Releases. The maximum nondamaging discharge capacity of the channel immediately downstream of Barre Falls Dam is about 1,000 cfs. Releases at or near this rate can be expected whenever reservoir inflows

exceed this value, and meteorologic and hydrologic conditions permit.

#### 6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 28 New England Division flood control dams, and continually monitors rainfall, snow cover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

#### 7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern is a portion of the central region of Massachusetts in the vicinity of Barre Falls Dam. Table 1 contains information about public water suppliers in this mostly rural area based on information provided by the Massachusetts Department of Environmental Management Division of Water Resources. Of the eight communities viewed as potential users of water from Barre Falls Dam during drought conditions, only three of the communities are served by a public water supply system. No data is available for those areas dependent on private individual water supplies.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Barre Falls Dam which could benefit from storage at the project and present the data in a manner accurately portraying existing water supply conditions. Projections of future demands were not developed because this study only addresses modifications in the operational procedure at Barre Falls Dam in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. Public Water Suppliers. As noted in table 1, the data given for each water supplier in the vicinity of Barre Falls Dam includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1980, estimated safe yield of supply sources, and any further information available on the source of supply.



Table 1  
Major Water Suppliers - Vicinity of Barre Falls Dam

| <u>Company<br/>or Agency</u>    | <u>Town<br/>Served</u> | <u>Est. Population<br/>Served - 1980</u> | <u>Source of Supply<br/>SW/GW</u> | <u>1980 Demand</u>        |                           | <u>Safe Yield<br/>(MGD)</u> | <u>Comments</u>            |
|---------------------------------|------------------------|--|-----------------------------------|---------------------------|---------------------------|-----------------------------|----------------------------|
|                                 |                        |  |                                   | <u>Avg. Day<br/>(MGD)</u> | <u>Max. Day<br/>(MGD)</u> |                             |                            |
| Barre Water Dept.               | Barre                  | 2,766                                    | SW/GW                             | 0.250                     | 0.370                     | 0.675                       | 2 Wells<br>Barre Reservoir |
| Barre Wool<br>Combing Co.       | Barre                  | 270                                      | GW                                | 0.020                     | 0.030                     | 0.950                       | 1 Well                     |
| Hardwick Ct.<br>Water Dept.     | Hardwick               | 63                                       | GW                                | 0.009                     | 0.014                     | 0.019                       | 1 Well                     |
| Gilbertsville<br>Water District | Hardwick               | 1,215                                    | GW                                | 0.074                     | 0.112                     | 0.150                       | 1 Well                     |
| Wheelwright<br>Water District   | Hardwick               | 286                                      | GW                                | 0.039                     | 0.039                     | 0.418                       | 2 Wells                    |
|                                 | Hubbardston            |  | No Public Water Supply            |                           |                           |                             |                            |
|                                 | New Braintree          |  | No Public Water Supply            |                           |                           |                             |                            |
|                                 | Oakham                 |  | No Public Water Supply            |                           |                           |                             |                            |
|                                 | Petersham              |  | No Public Water Supply            |                           |                           |                             |                            |
|                                 | Phillipston            |  | No Public Water Supply            |                           |                           |                             |                            |
| Rutland Water<br>Dept.          | Rutland                | 2,770                                    | SW                                | 0.240                     | 0.500                     | 0.225                       | Maschopauge Pond           |
| Cool Sandy<br>Beach Co.         | Rutland                | 95                                       | GW                                | -                         | -                         | -                           | Seasonally Used            |

An analysis of adequacy of existing sources during drought conditions was not performed. The information has been accumulated to present a summary of the existing water supply conditions for area communities in the vicinity of Barre Falls Dam.

d. Population Projections. Population projections for communities in the immediate vicinity of Barre Falls Dam are given in table 2 to show population trends for each community potentially affected by a prolonged dry period. The projections for these communities were provided by the Massachusetts Department of Environmental Management Division of Water Resources. As can be seen from the table, an increase in population for the area as a whole is projected for the time period 1980-2000, although this increase, as a result of the rural nature of the area, amounts to only about 3,000 new residents in the area.

## 8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 directs field offices to determine the short-term water supply capability of existing Corps reservoirs. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

### b. Drought Contingency Storage

(1) General. Large portions of the Swift and Ware River watersheds are owned by, and controlled through, facilities of the Metropolitan District Commission (MDC) of the Commonwealth of Massachusetts for use as a source of water supply for Metropolitan Boston. The facilities consist of the Coldbrook Intake and Quabbin Reservoir, in the Ware River and Swift River watersheds, respectively. The Coldbrook intake, located downstream of Barre Falls, diverts water from the Ware River into the MDC system (i.e., Quabbin Reservoir and occasionally Wachusett Reservoir). The reservoir lands associated with Barre Falls, except for a small operating area, are owned by the MDC. Flow easements have been acquired by the Corps at Barre Falls, allowing for flood

Table 2  
Population Projections - Communities Near Barre Falls Dam

| <u>Town</u>   | <u>Actual<br/>1980</u>        | <u>1985</u>                   | <u>1990</u>                   | <u>1995</u>                   | <u>2000</u>                   | <u>Percent<br/>Change</u>  |
|---------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|----------------------------|
| Barre         | 4,102                         | 4,175                         | 4,200                         | 4,225                         | 4,250                         | 3.5                        |
| Hardwick      | 2,272                         | 2,325                         | 2,375                         | 2,400                         | 2,425                         | 6.7                        |
| Hubbardston   | 1,797                         | 2,013                         | 2,229                         | 2,444                         | 2,660                         | 48.0                       |
| New Braintree | 671                           | 750                           | 775                           | 825                           | 850                           | 26.7                       |
| Oakham        | 994                           | 1,050                         | 1,100                         | 1,125                         | 1,175                         | 18.2                       |
| Pertersham    | 1,024                         | 1,029                         | 1,034                         | 1,039                         | 1,044                         | 2.0                        |
| Phillipston   | 953                           | 993                           | 1,034                         | 1,075                         | 1,115                         | 17.0                       |
| Rutland       | <u>4,334</u><br><u>16,147</u> | <u>4,650</u><br><u>16,985</u> | <u>4,975</u><br><u>17,722</u> | <u>5,275</u><br><u>18,408</u> | <u>5,600</u><br><u>19,119</u> | <u>29.2</u><br><u>18.4</u> |

control storage. Releases of excess floodwaters from Barre Falls Dam are coordinated with the MDC water supply operations.

(2) Coldbrook Intake. The Coldbrook intake is located approximately 4 miles downstream of Barre Falls Dam, and controls about 45 percent of the 216 square mile drainage area of the Ware River. The function of the intake structure is to divert water from the Ware River to the MDC system via a series of aqueducts.

The normal diversion period is 6 months (1 December to 31 May) but may be extended to 8 months (15 October to 15 June) if approved by the Massachusetts Board of Health. The maximum diversion capacity of the intake to Quabbin Reservoir is 890 cfs and the combined capacity to both Wachusett and Quabbin Reservoirs is 2,960 cfs. The MDC is required by law to allow 132 cfs to pass the Coldbrook Intake for use by downstream interests. Efforts are made to coordinate floodwater releases from Barre Falls with the MDC so as not to exceed their diversion capacity if water is needed within their system.

(3) Effects of MDC Water Supply Operations. Because of the existing MDC water supply operations within the Ware River watershed, drought contingency storage plans are precluded at Barre Falls. The MDC system, however, does not directly benefit the Swift and Ware River watersheds as the system's service area is Metropolitan Boston. In an emergency, state legislation could be enacted to allow communities in the Swift and Ware watersheds to obtain water from the MDC system. As most of the communities do not have the distribution facilities to enable them to tap directly into the MDC system, they would have to rely on pumping from the Quabbin Reservoir into containment vessels for transport back to the communities.

As the MDC does not divert flows during the summer months, it is possible that if a severe drought emergency were to occur during that time period, water could be stored at Barre Falls, or added diversion of the Ware River flows could be permitted at the Coldbrook intake. The curtailment of flows from Barre Falls during a drought emergency could adversely impact on the flowage rights of downstream riparian users, including the MDC. At this time it is not possible to review all of the various drought emergency situations that could occur, nor is it within the scope of this report to identify all those with water rights. It is important to note that

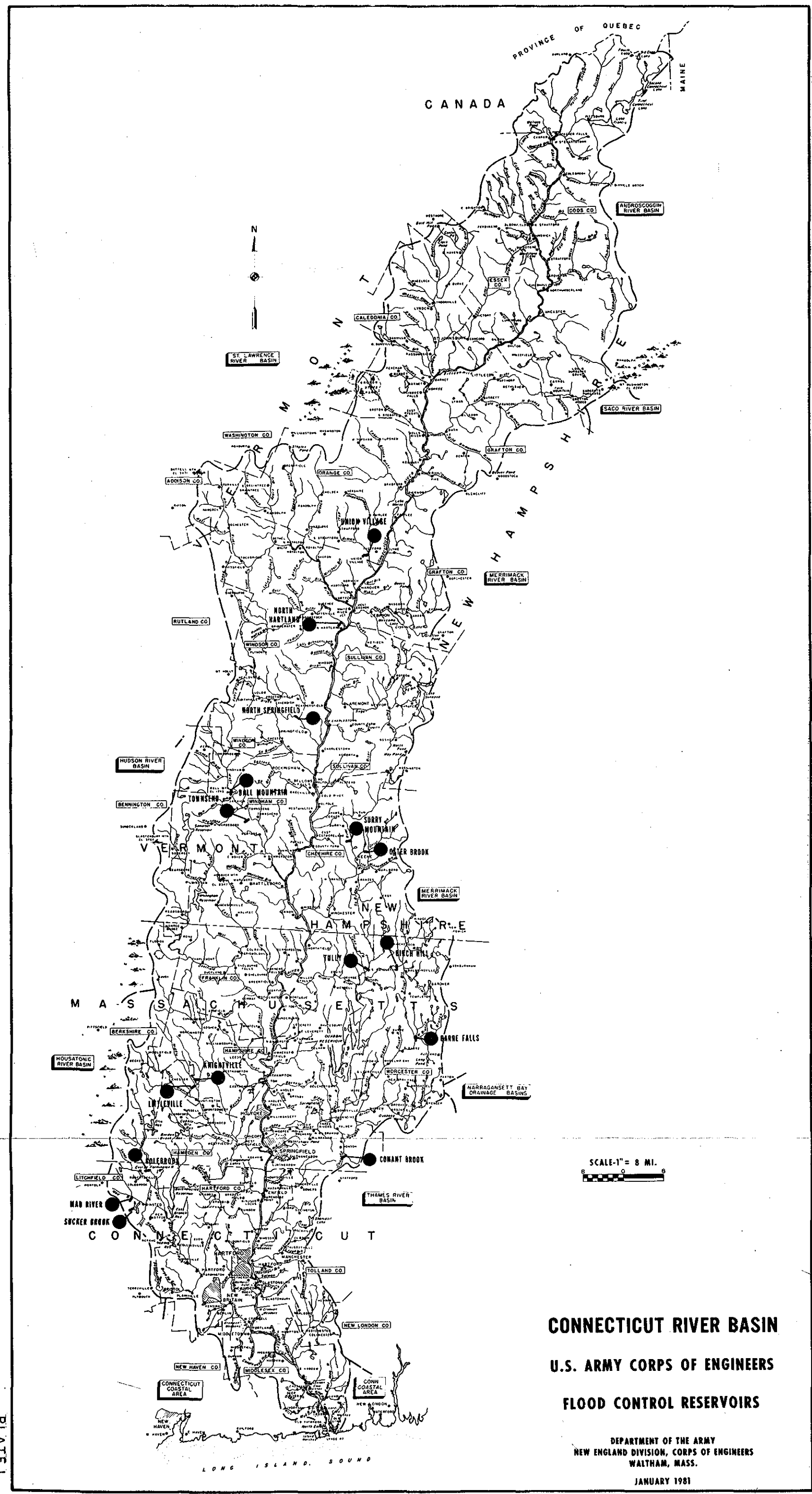
when a specific drought emergency does occur, the legal implications would have to be weighed.

#### 9. WATER QUALITY EVALUATION

The water quality of the Ware River at Barre Falls Dam meets Massachusetts class A water quality standards but is not suitable for public water supply without treatment. The water is highly colored, low in pH, and has high levels of iron and manganese. All of these conditions are due to the natural effects of swamps and marshes in the watershed. After the water is diverted to Quabbin Reservoir, natural processes in the reservoir eliminate these undesirable characteristics and make the water ultimately acceptable for public water supply. For these reasons, the present mode of operation at Barre Falls Dam for water supply is the best from a water quality perspective.

#### 10. SUMMARY AND CONCLUSIONS

Under current provisions, releases of excess floodwaters from Barre Falls Dam are coordinated with the water supply operation of the Metropolitan District Commission of the Commonwealth of Massachusetts. The released water from Barre Falls is diverted into the MDC system via the Coldbrook intake. This existing operational procedure would preclude the development of a drought contingency storage plan at Barre Falls Dam. In an emergency, State legislation might be enacted permitting added diversion of Ware River flows at the Coldbrook intake thereby maximizing water supply potential of the river, without need for drought contingency storage at Barre Falls.



**CONNECTICUT RIVER BASIN**  
**U.S. ARMY CORPS OF ENGINEERS**  
**FLOOD CONTROL RESERVOIRS**

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASS.  
JANUARY 1981

BARRE FALLS DAM  
AREA AND CAPACITY

DRAINAGE AREA = 55 SQ. MI.

| <u>Elev.</u><br><u>(msl)</u> | <u>Stage</u><br><u>(ft)</u> | <u>Area</u><br><u>(acres)</u> | <u>Capacity</u> |               | <u>Elev.</u><br><u>(msl)</u> | <u>Stage</u><br><u>(ft)</u> | <u>Area</u><br><u>(acres)</u> | <u>Capacity</u> |               |
|------------------------------|-----------------------------|-------------------------------|-----------------|---------------|------------------------------|-----------------------------|-------------------------------|-----------------|---------------|
|                              |                             |                               | <u>Ac-Feet</u>  | <u>Inches</u> |                              |                             |                               | <u>Ac-Feet</u>  | <u>Inches</u> |
| 770                          | 0                           | 0                             | 0               | 0.00          | 789                          | 19                          | 620                           | 5510            | 1.88          |
|                              |                             |                               |                 |               | 790                          | 20                          | 660                           | 6170            | 2.10          |
| 771                          | 1                           | 20                            | 15              | .01           | 791                          | 21                          | 700                           | 6870            | 2.34          |
| 772                          | 2                           | 50                            | 60              | .02           | 792                          | 22                          | 740                           | 7610            | 2.59          |
| 773                          | 3                           | 80                            | 120             | .04           | 793                          | 23                          | 790                           | 8410            | 2.86          |
| 774                          | 4                           | 100                           | 220             | .07           | 794                          | 24                          | 830                           | 9250            | 3.15          |
| 775                          | 5                           | 125                           | 340             | .12           | 795                          | 25                          | 870                           | 10100           | 3.44          |
| 776                          | 6                           | 160                           | 490             | .17           | 796                          | 26                          | 920                           | 11000           | 3.75          |
| 777                          | 7                           | 180                           | 670             | .23           | 797                          | 27                          | 960                           | 12000           | 4.09          |
| 778                          | 8                           | 215                           | 880             | .30           | 798                          | 28                          | 1000                          | 13000           | 4.46          |
| 779                          | 9                           | 245                           | 1120            | .38           | 799                          | 29                          | 1040                          | 14100           | 4.80          |
| 780                          | 10                          | 280                           | 1390            | .47           | 800                          | 30                          | 1090                          | 15200           | 5.18          |
| 781                          | 11                          | 320                           | 1700            | .58           | 801                          | 31                          | 1140                          | 16300           | 5.55          |
| 782                          | 12                          | 360                           | 2050            | .70           | 802                          | 32                          | 1180                          | 17500           | 5.96          |
| 783                          | 13                          | 390                           | 2430            | .83           | 803                          | 33                          | 1220                          | 18700           | 6.37          |
| 784                          | 14                          | 430                           | 2850            | .97           | 804                          | 34                          | 1260                          | 20000           | 6.81          |
| 785                          | 15                          | 460                           | 3300            | 1.12          | 805                          | 35                          | 1300                          | 21300           | 7.26          |
| 786                          | 16                          | 500                           | 3790            | 1.29          | 806                          | 36                          | 1350                          | 22600           | 7.70          |
| 787                          | 17                          | 540                           | 4320            | 1.47          | 807                          | 37                          | 1400                          | 24000           | 8.20          |
| 788                          | 18                          | 580                           | 4900            | 1.67          |                              |                             |                               |                 |               |

Crest Elevation = 807

Invert Elevation = 761 due to  
9 foot drop at inlet channel.

PERTINENT DATA  
BARRE FALLS DAM

July 1978

LOCATION Ware River; Barre, Massachusetts

DRAINAGE AREA 55 Square Miles

STORAGE USES Flood Control

RESERVOIR STORAGE

|                   | <u>Elevation</u><br>(ft msl) | <u>Stage</u><br>(ft) | <u>Area</u><br>(acres) | <u>Capacity</u><br><u>Acre-Feet</u> | <u>Inches on</u><br><u>Drainage Area</u> |
|-------------------|------------------------------|----------------------|------------------------|-------------------------------------|--|
| Inlet Elevation   | 761                          | 0                    | 0                      | 0                                   | 0  |
| Spillway Crest    | 807                          | 46                   | 1,400                  | 24,000                              | 8.2                                      |
| Maximum Surcharge | 825                          | 64                   | 2,950                  | 63,000                              | 21.5                                     |
| Top of Dam        | 830                          | 69                   | -                      | -                                   | -  |

EMBANKMENT FEATURES

|                    |  | <u>Dikes</u>  |
|--------------------|--|---------------|
| Type               | <u>Main Dam</u> - Rolled earth fill with rock protection | 3             |
| Length (feet)      | 885  | 3,215 (total) |
| Top Width (feet)   | 25   | 15            |
| Top Elev. (ft msl) | 830  | 830           |
| Max. Height (ft)   | 69   | 48            |

SPILLWAY

|                      |  |
|----------------------|--|
| Location             | Right abutment of the dam                      |
| Type                 | Uncontrolled ogee weir, chute spillway in rock |
| Crest Length (feet)  | 60   |
| Crest Elev. (ft msl) | 807  |
| Max. Surcharge (ft)  | 18.0   |
| Maximum Discharge    |  |
| Capacity (cfs)       | 16,300   |

SPILLWAY DESIGN FLOOD

|                         | <u>Original Design</u> | <u>1973 Studies</u> |
|-------------------------|------------------------|---------------------|
| Peak Inflow (cfs)       | 68,300                 | 61,000              |
| Peak Outflow (cfs)      | 16,300 (spillway only) | 14,800              |
| Volume Runoff (Ac. Ft.) | 62,500                 | 55,500              |

OUTLET WORKS

|                      |  |
|----------------------|--|
| Type                 | Horseshoe conduit                        |
| Tunnel Inside        | 9'8" diameter                            |
| Tunnel Length (ft)   | 250                                      |
| Service Gate Type    | Electrically operated gear driven sluice |
| Size                 | Two 4.5' wide x 9.0' high                |
| Emergency Gate Type  | None                                     |
| Downstream Channel   |  |
| Capacity (cfs)       | 1,000                                    |
| Discharge Cap. at    |  |
| Spillway Crest (cfs) | 3,000                                    |

LAND ACQUISITION

|                   |                                    |
|-------------------|------------------------------------|
| Guide Taking Line | 815 ft msl (both fee and easement) |
| Fee (acres)       | 557                                |
| Easement (acres)  | 1,869                              |

MAXIMUM POOL OF RECORD

|                    |            |
|--------------------|------------|
| Date               | April 1960 |
| Stage (feet)       | 36.5       |
| Elevation (ft msl) | 797.9      |
| Percent Full       | 50         |

UNIT RUNOFF

|                           |       |
|---------------------------|-------|
| One Inch Runoff (Ac. Ft.) | 2,935 |
|---------------------------|-------|

OPERATING TIME

|                      |            |
|----------------------|------------|
| Open/close all gates | 1 foot/min |
|----------------------|------------|

PROJECT COST (THROUGH FY 1977) \$1,968,000

DATE OF COMPLETION July 1958

MAINTAINED BY New England Division, Corps of Engineers